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ABSTRACT

Making educational programs fit the needs of individual learners has long been a goal of education. Project PLAN is a first attempt at computerizing the planning of an individual's educational program. Utilizing information on a student's past academic record, state and local requirements, teacher recommendations, instructional resources, the student's interest and abilities, and parental wishes, the computer can prepare a long-range instructional program for the student which satisfies a hierarchy of goals at a level of difficulty and in a format which is best suited to the individual student. (RH)

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THE ACCOMMODATION OF INDIVIDUAL DIFFERENCES IN THE DEVELOPMENT OF PERSONAL PROGRAMS OF STUDY

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It has long been the goal of education to make educational programs more fully fit the needs of individual learners. It is in this area that the next major step forward in the improvement of education must take place. And it is toward this goal that Project PLAN is working. It is hoped that PLAN will be able to mobilize the resources of contemporary education toward the satisfaction of the specific needs of individual children. The purpose of this paper is to describe one aspect of the PLAN enterprise; namely, the process by which programs of study are generated for individual students.

There are two distinct, but interconnected, curriculum problems to be considered in dealing with the question of individualized programs of study. They are: (1) how the curriculum should be defined; and (2) how the curriculum should be implemented. Both are essential. The former involves not only what should be learned, but also how much should be learned, when it should be learned, and how fast it should be learned. While the present paper is concerned primarily with how the curriculum should be implemented, it would be well to begin by putting these issues in perspective.

HOW THE CURRICULUM SHOULD BE DEFINED

Our society has traditionally been, and continues to be, a pragmatic one. Interest in education in our society has always been on its practical implication. Even though there has often been disagreement as to what was most practical, it is reasonably accurate to state that the curriculum effort of the late nineteenth and early twentieth centuries was based fundamentally on the acceptance of Herbert Spencer's 1859 argument that what a child most needed to learn was that which would be most

useful to him as an adult (Kearney & Cook, 1960).

On the one hand were those theorists who emphasized the importance of mastery of formal disciplines. They did so not so much because of the intrinsic value of the material per se, but rather because they considered sound disciplinary training the best preparation for the demands of adulthood. On the other hand were those who challenged the theory of formal discipline and who argued that one should base curriculum considerations on more explicit, empirically demonstrable, considerations.

The underlying differences between the disciplinists and empiricists came to the fore in 1895 with the recommendations of the Committee of Fifteen. The Committee of Fifteen had been concerned with establishing a set of guidelines which would be to elementary education what the recommendations of the better known Committee of Ten (1893) were for secondary education; i.e., the standardization of the format of elementary education. Instead of achieving their goal they succeeded only in polarizing the views of the educational community and in precipitating what Drost (1967) has described as the "Great Curriculum Debate." At the heart of the debate was the question of whether content should be selected for its direct utilitarian value, or for its contribution to the maintenance and/or enhancement of the integrity of a given subject field. The debate continues to this day.

On one side of the debate, Bruner (1960), concerned with the exponential explosion of information, has suggested reorganization of the educational curriculum even to the point of eliminating such traditional fields as history. On the other the trend of the various curriculum projects such as Harvard Project Physics, the School Mathematics Study Group

(SMSG), the Biological Sciences Curriculum Study (BSCS), and the like, has been to create more and more intensive, and elegant, disciplinary programs. In these programs, apparently little regard has been given to how much of the field is necessary for practical living, or even what proportion of public school students will want, or be able to complete, their various courses of study. (Bellack, 1969; NcNeil, 1969.)

HOW THE CURRICULUM SHOULD BE IMPLEMENTED

The Committee of Ten had earlier (1893) wrestled with the problem of how best to implement a more individualized secondary school program. Their solution was very simple, and, with only slight modification in 1918, it set the mode of secondary education for half a century (Sizer, 1964). In essence, the recommendations called for the establishment, and standardization, of a set of core courses which would comprise the educational base of all students. Collateral with these basic requirements would be an array of "elective" courses which could then be selected by the student on the basis of his interest. This paradigm still has clear contemporary relevance and remains the standard educational pattern.

The Committee of Ten individualized programs by permitting differential content exposure. The unit of content exposure, in this case, was the "course." Later elaborations of the paradigm involved the identification of various sub-programs such as vocational, business, general, and college preparatory, while still preserving the student elective option. Responsibility for "tracking" students into these various programs was, for the most part, retained by the schools.

More recently, programmed instruction, and various other forms of modern instructional technology, have skirted the issue of what is to be

studied. And, since they generally require content mastery, these procedures individualize instruction by allowing variability in the amount of exposure that the content gets. In this way individual differences in learning rate are allowed to operate.

In addition to individualization based on what is to be learned, and individualization based on amount of exposure to that which is to be learned, individualization must also be based on how one will learn, i.e., on learning style, on the various ways in which the content to be learned may be studied. Contemporary individualized educational programs, if they are to lay claim to that title, must begin to accept some responsibility vis-a-vis the differential selection of the material from which the student is to learn.

In particular, individualization of educational programs must consider among other things:

1) what the student needs to know,
2) what the student would like to know,
3) what the student already knows,
4) the rate at which the selected content should be presented,
5) the sequence in which that content should be presented,
6) the size of the steps in the sequence of that content,
7) the mode of presentation of that content,
8) the amount, type, and schedule of feedback associated with the presentation of that content,
9) the difficulty level of the learning materials used to teach the content,
10) the meaningfulness of the content to the individual learner,

11) the nature of the physical and social context in which the teaching-learning takes place,

12) the contemporary affect state, including the motivational state, of the learner at the time of learning,

13) the amount of teacher supervision--media richness--technology involved,

14) the amount of variation provided for in the learning program,

15) the amount of overlearning, and/or, periodic review built into the program.

To do this it is necessary to move toward an ungraded program, toward individualized rather than group testing, and toward criterion normed rather than group normed tests. This of course imposes problems on administration. And evaluation of the program cannot rest on such simple and traditional criteria as significant differences in the mean achievement scores of experimental and control groups because standardized testing is based on the assumption of fixed exposure to a common content.

In addition, if one insists that the curriculum should be relevant, one must know relevant for what. That is, one must know what goals the child has set for himself so that one may decide whether or not the content to be assigned is in fact relevant.

Such individualized education imposes a massive monitoring task; a task that cannot be done without the aid of computer support services. These services are available in PLAN and with those services we are attempting to accomplish as much of the preceding as possible.

PLAN PROCEDURES FOR 1969

In the next few days approximately 9000 PLAN students in 61 different

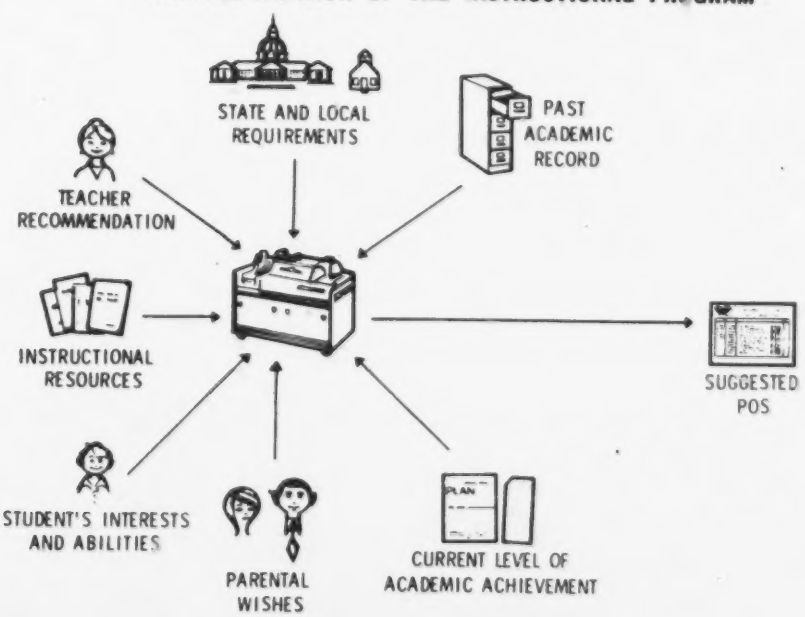
school buildings in 17 different school systems will be entering school. Each student will receive an individualized Program of Study. We do not offer these programs as ideal, but they are real, and they represent, as far as can be ascertained, the largest such effort at purposeful individualization in education to date.

The following will briefly summarize the paradigm for the development of a PLAN Program of Studies. It will be presented in its most complex form--i.e. the form used for secondary school programs. The procedure is scaled down for use at the lower grades where some of the more complex variables such as long range vocational goals, educational aspirations, and the like, lose relevance.

Instructional Resources. There are over 1000 lessons (or modules) in PLAN, divided across nine operating grades and four subject matter

FIGURE 1

INDIVIDUALIZATION OF THE INSTRUCTIONAL PROGRAM



areas. At the secondary level there are approximately 85 modules per subject area. This would yield, on the average, approximately 170 weeks of instruction distributed across grades 9, 10, and 11. The typical student, in the typical secondary school, which operates an average of 38 weeks in the school year, would have, excluding final examination periods, special vacations and the like, an average of 110 weeks available for formal instruction. So, for the hypothetical student a Program of Studies can be derived from a lesson bank containing over half again as much work as the student could reasonably be expected to accomplish. In addition, each of these modules is offered, on the average, in two different forms called teaching-learning units (TLU's).

It is not enough to simply have an extremely rich lesson bank, however. For individualized education, the lesson bank must be coded so that certain lessons can be retrieved for the particular needs of specific students. Each of the more than 1000 modules and 1700 TLU's in the PLAN system are coded along a variety of dimensions.

Each module is coded as to whether or not it is a part of a state or local requirement; essential for a given educational or occupational area; highly desirable for that area; essential for minimal functioning as a citizen; highly desirable for all citizens to know; or would make the individual a particularly well-informed citizen.

Each teaching-learning-unit is coded as to its reading difficulty; the degree to which it requires teacher supervision; its media richness characteristic; the degree to which it requires social involvement and/or group learning activities; the amount of reading involved; and the variety of activities inherent in the unit.

The Individual Data Base. In order to use this cross-referenced lesson bank for the development of individualized Programs of Study, it is also necessary to have information about the needs, interests, abilities and aspirations of the individual for whom the Program of Study is to be generated. To this end, data on the following variables were collected:

1) parent and student educational goal;
2) parent and student vocational aspiration;
3) student's vocational interests;
4) student's level of achievement;
5) student's level of developed abilities (on such dimensions as reading comprehension, arithmetic reasoning, and the like);
6) the student's recall of past studies;
7) and the student's learning style.

Learning style was defined as: a) need for teacher supervision; b) need for social involvement; c) need for media richness; d) need for variety of learning activities; and e) preference for reading.

Data on parent-student vocational and educational aspirations were collected via parent-student questionnaires. This information was used to identify parent-student long range goals. Student interests, achievement levels, and developed abilities are obtained from the Expressed Interest Inventory, the PLAN Achievement Tests and the Developed Abilities Performance Tests. Information regarding the student's optimum learning style was obtained from a series of student ratings made by his teacher.

From information about the student's developed abilities, a second long range vocational goal was generated for the student, using TALENT based regression equations. This "data suggested" LRG was used to supple-

ment the parent-student planning so the student would have as many realistic options open as possible. The student's two long range goal (LRG) categories plus his expressed interests carry a major role in determining what content will be recommended for him. His level of tested achievement, plus his record of past studies in Project PLAN, determine his placement and quota of modules.

Module Assignment. The process in generating what lessons are to be recommended for a student is as follows: given information about a student's long range goals, his expressed interests, citizenship requirements, and state and local school requirements, the computer generates a three year list of recommended modules arranged in the following order: 1) state requirements; 2) local requirements; 3) essential citizenship requirements; 4) parent-student long range goal requirements; 5) modules which are highly desirable given parent-student long range goals; 6) data suggested LRG requirements; and 7) data suggested highly desired experiences. This list is then followed by modules selected alternately on the basis of probable interest and citizenship. This alternating selection process is continued until the student's quota is filled. His quota is based on the measured level of the student's developed abilities plus data on the number of modules he completed in PLAN the preceding year.

This process gives a three year list which is then broken into annual increments. Each increment is composed of one-third of the requirements identified above plus one-third of the highly desirable modules identified above plus one-third of the iterative process modules described above.

Regarding placement, on the basis of the individual's tested achievement plus his record of past studies in PLAN, the child is given credit

for the material he already knows. If there is material for which he cannot demonstrate mastery and which is considered prerequisite to modules to which he is assigned, the prerequisite material is also assigned.

TLU Selection. At this point, specific TLU assignment takes place. Up to now the consideration has only been toward identification of the content to be studied, i.e., which lessons, how many lessons, and in what sequence the lessons should be taken. The next question is learning style, i.e., which particular TLU's the student should study in order to maximize the likelihood of his mastering the content as quickly as possible. It is at this point that the computer, from a complex set of decision rules, matches the student with specific TLU's.

The results of these decisions are then printed as a formal Program of Study for the student. It is printed in two copies, one for school record keeping, and the other for teacher-student classroom use. Figure 2 shows a sample of the POS format.

Conclusion. In conclusion, it may be said that a student's recommended POS is not a fixed entity. The teacher can add or delete modules to the POS with ease. If she chooses, she can even totally revise the recommended Program of Studies. A formal change in the POS can be made by simply indicating the number of the module she would like to delete or add. Barring this, the teacher can even effect a change in the POS by simply having the student study a module or TLU not on his POS. Then, when the student's Status Card is filed with the computer terminal, the computer notes that the module or TLU is different from any on the student's recommended POS and asks the teacher to verify that a coding mistake on the Status Card has not been made, i.e., that the new selection is in fact a

PLAN

PROGRAM OF STUDIES AND STUDENT PROGRESS REPORT FOR **EAGER VERNON**

060140-02-0 SCHOOL **ADDISON** TEACHER **MRS. ETHEL BARKER** SUBJECT AREA **LANGUAGE ARTS** DATE **11/16/69**

COMPLETION CODE	MODULE NUMBER	MODULE NAME	DATE FINISHED
COMPLETED	81-051-0	LANGUAGE ARTS ACHIEVEMENT TEST	
COMPLETED	12-059-0	SULLIVAN BOOK 12(A)	
ACTIVE	10-101-0	ABOUT MYSELF	
ACTIVE	12-060-0	SULLIVAN BOOK 12 (B)	
	12-061-3	SULLIVAN BOOK 13 (A)	
	12-062-3	SULLIVAN BOOK 13 (B)	
	12-063-3	SULLIVAN BOOK 14 (A)	
	12-064-3	SULLIVAN BOOK 14 (B)	
	10-107-3	DRAMATICS	
	10-108-3	WINDY, RAINY, AND SUNNY DAYS	
	10-109-3	STORY WRITING	
	10-110-3	A VISIT ON PAPER	
	10-111-3	BEARS ON HEMLOCK MOUNTAIN	
	10-112-3	ANIMAL STORIES	
	10-113-3	AND TO THINK THAT I SAW IT ON MULBERRY STREET	
	10-114-3	THANK YOU, MR. BELL	
	11-151-3	PEGASUS	
	13-161-3	SUBJECT, PREDICATES, AND NOUNS	
	11-152-3	THUNDER	
	11-153-3	THE KNIGHT	
	11-154-3	THE SAD TIGER	
	13-162-3	PROPER NOUNS, COMMON NOUNS, AND DETERMINERS	
	11-155-3	SUSY'S FEARS	
	11-156-3	SMILES FARM	
	11-157-3	THE ROUNDABOUTS SECRET	
	13-163-3	PRONOUNS AND SUBJECTS	
	11-158-3	BUGABOO	

FIGURE 2

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deliberate selection. Upon confirmation, the computer adds the new selection to the student's Program of Studies file automatically and from that point forward it is carried in his record.

As one might expect, with programs of the complexity described, and given the current state of sophistication with regard to the requisite data necessary for sophisticated individualization, a large number of arbitrary, interim decisions had to be made. As was indicated, the 1969 PLAN POS procedure is not offered as a finished model. It is not the best of all possible procedures; it is, rather, a first operating prototype. As additional sophistication is achieved in the identification of specific student needs, the identification of those aspects of currently available instructional materials that are relevant to the needs of youth, and ways to further accommodate individual differences in learning style, the POS procedures will be modified accordingly.

It is important to say, however, that a procedure such as this offers research capability of uncommon proportions. Some of the specific questions being asked of this year's POS data are: 1) how similar are student-parent long range goals to the "best fit" goals suggested by the level and pattern of the student's developed abilities; 2) what proportion of a typical school curriculum is in fact relevant to the long-range vocational goals of youth; 3) to what long-range educational and vocational goals do youth currently aspire, and the like. By this time next year, empirical data on the effectiveness and the specific operating characteristics of this model will be available and a second generation procedure will be in use on a sample of approximately 40,000 students.